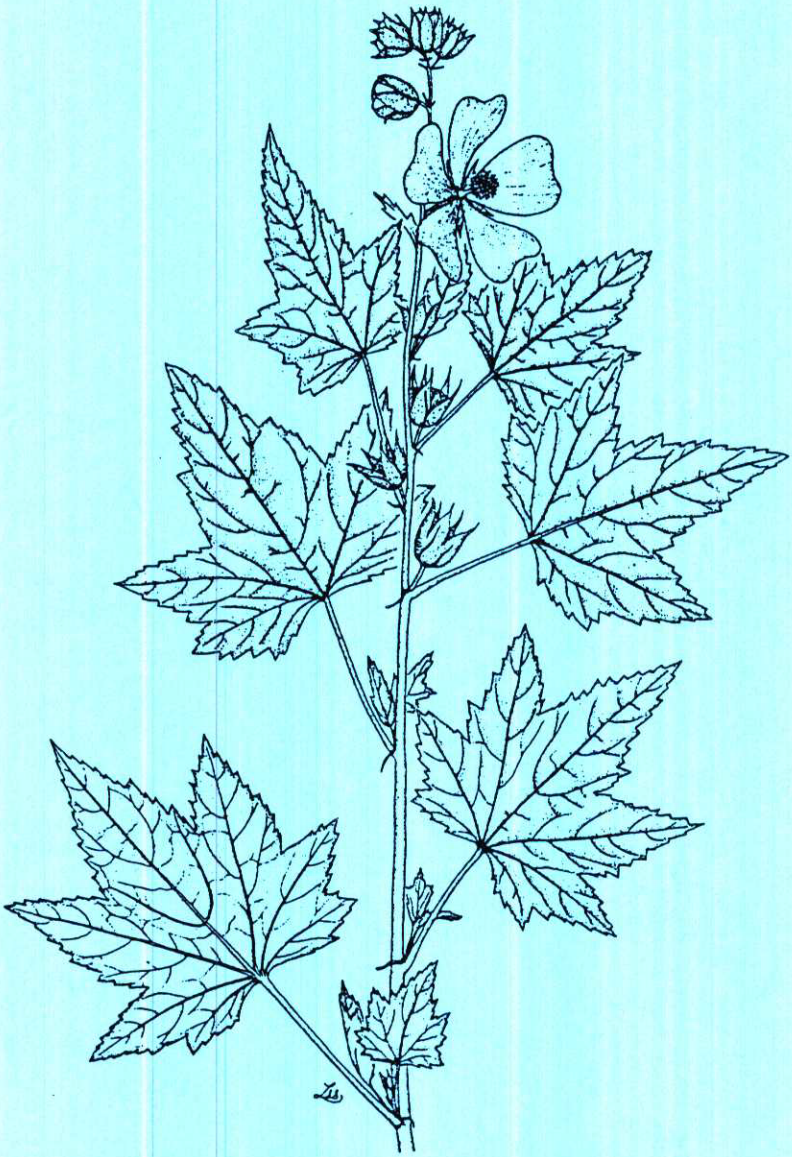
Peters Mountain Mallow

(Iliamna corei)



Recovery Plan

Region Five
U.S. Fish and Wildlife Service

Peters Mountain Mallow

(Iliamna corei (Sherff) Sherff)

RECOVERY PLAN

Prepared by:

Judy Jacobs
Annapolis Field Office
U.S. Fish and Wildlife Service

in cooperation with
Virginia Polytechnic Institute and State University

For:

Region 5
U.S. Fish and Wildlife Service
Newton Corner, Massachusetts

Approved: _____
ACTING Regional Director, Northeast Region
U.S. Fish and Wildlife Service

Date: SEP 2 8 1990

EXECUTIVE SUMMARY – PETERS MOUNTAIN MALLOW

Current Status: The single present and only known historical population occurs on Peters Mountain, above The Narrows of the New River, in Giles County, Virginia. Only 4 individuals remain in this population. However, this plant is also in cultivation at Virginia Polytechnic Institute and State University experimental gardens, Blacksburg, VA, and at the North Carolina Botanical Garden, Chapel Hill, NC.

Limiting Factors: Since its discovery in 1927, Peters Mountain mallow has declined from an estimated 50 plants to its present level. This decline is apparently due to fire suppression, resulting in lack of recruitment, and the invasion of weedy competitors; deer browsing; and lack of opportunity for outcrossing in recent years.

Recovery Objective: To delist Peters Mountain mallow.

Recovery Criteria: The species can be downlisted to threatened when:

1. The natural population has reached carrying capacity and has been self-maintaining or expanding into new areas for at least 5 years;
2. Life history, ecology, and population biology are understood sufficiently to manage effectively;
3. There exists an established and continuing management program;
4. The tract of land on which it occurs is permanently protected; and
5. Plants representing a variety of genotypes are propagated at a minimum of two plant breeding facilities.

The species may be removed from threatened status if and when:

6. Studies indicate that it is appropriate to establish new populations;
7. Five additional populations have been located or established; and
8. These new populations are protected and stable or expanding for at least 5 years.

Actions Needed:

1. Monitor known population and manage as necessary.
2. Study life history, ecological, and population parameters.
3. Maintain representative individuals at two plant breeding facilities.
4. Outplant individuals within historic range.
5. Acquire full title to the population site.

Projected Costs (x $1000):

YEAR	NEED 1	NEED 2	NEED 3	NEED 4	NEED 5	TOTAL
1990	2.5	6.0				8.5
1991	2.5	19.0	2.0		60.0	83.5
1992	2.5	20.5	2.0			25.0
1993	2.5		1.0	5.0		8.5
1994	2.5			5.0		7.5
1995	2.5			5.0		7.5
1996	2.5					2.5
1997	2.5					2.5
1998	2.5					2.5
1999	2.5					2.5
2000	2.5					2.5
TOTAL	27.5	33.0	5.0	15.0	60.0	153.0

DELISTING MAY BE INITIATED IN 1997-2000 (depending on study results and fate of transplants).

* * * *

The Peters Mountain Mallow Recovery Plan delineates reasonable actions that are believed to be required to recover and protect this endangered species. It has been prepared by the Annapolis Field Office of the U.S. Fish and Wildlife Service, in cooperation with Virginia Polytechnic Institute and State University. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. This recovery plan does not necessarily represent the views, official position, or approval of any individuals or agencies involved in plan formulation, other than the U.S. Fish and Wildlife Service. This plan is subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1990. Peters Mountain Mallow (Iliamna corei) Recovery Plan. Newton Corner, Massachusetts. 30 pp.

Additional copies of the plan can be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
301-492-6403
or
1-800-582-3421

Fees vary according to number of pages.

TABLE OF CONTENTS

LIST OF FIGURES

PART I: INTRODUCTION

Peters Mountain mallow (Iliamna corei), a member of the family Malvaceae, is known from only a single site on Peters Mountain, near The Narrows of the New River, in Giles County, Virginia (Figure 1). Due to its extremely localized distribution and vulnerability to naturally occurring and human-related threats, this species was listed as endangered, effective June 11, 1986. Iliamna corei is also listed as an endangered species under Virginia state law.

Iliamna corei was discovered in 1927 by Earl Core (Strausbaugh and Core, 1932). Core indicated that there were "no more than 50 plants" at that time. Since then, the number of plants has steadily declined (Figure 2). Keener and Hardin (1962) listed "40 clumps" (each with one to 15 plants); W. Grafton, West Virginia Department of Agriculture Extension, estimated 11 clumps (with 60 plants) in 1978; G. Frank (Assistant curator, Virginia Polytechnic Institute and State University Herbarium) found "9 plants" in 1980; S. Croy (The Nature Conservancy -- Virginia Chapter) listed five clumps in 1982 and 1984; J. Randall and T. Wieboldt (VPI&SU) counted only three individuals in 1986 through 1989. A fourth individual appeared in 1990.

It should be noted that because I. corei is rhizomatous and produces "clumps" of branches each year, there has been some disagreement as to the definition of an individual plant. This likely accounts for Dr. E. Meade McNeill's (Concord College, Athens, West Virginia) report of "more than 100 plants" of I. corei in 1937. For the purpose of this plan, an aggregation of stems or branches from one root crown is defined as a single individual (= ramet). A "clone" (= genet = clump) consists of all ramets connected with or originally arising from a single ancestor. Three distinct clones are presently known from Peters Mountain.

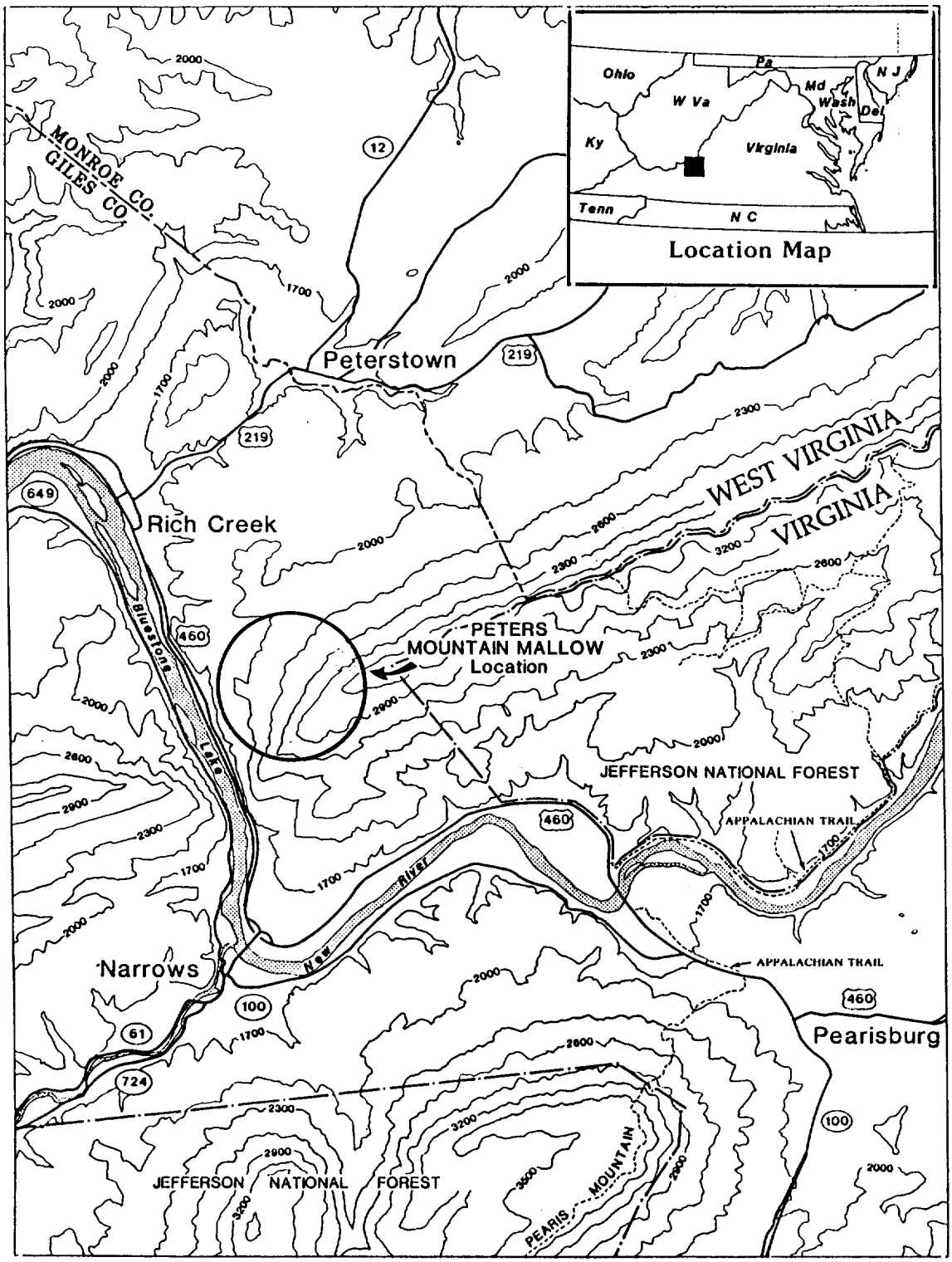


Figure 1. Location of Iliamna corei

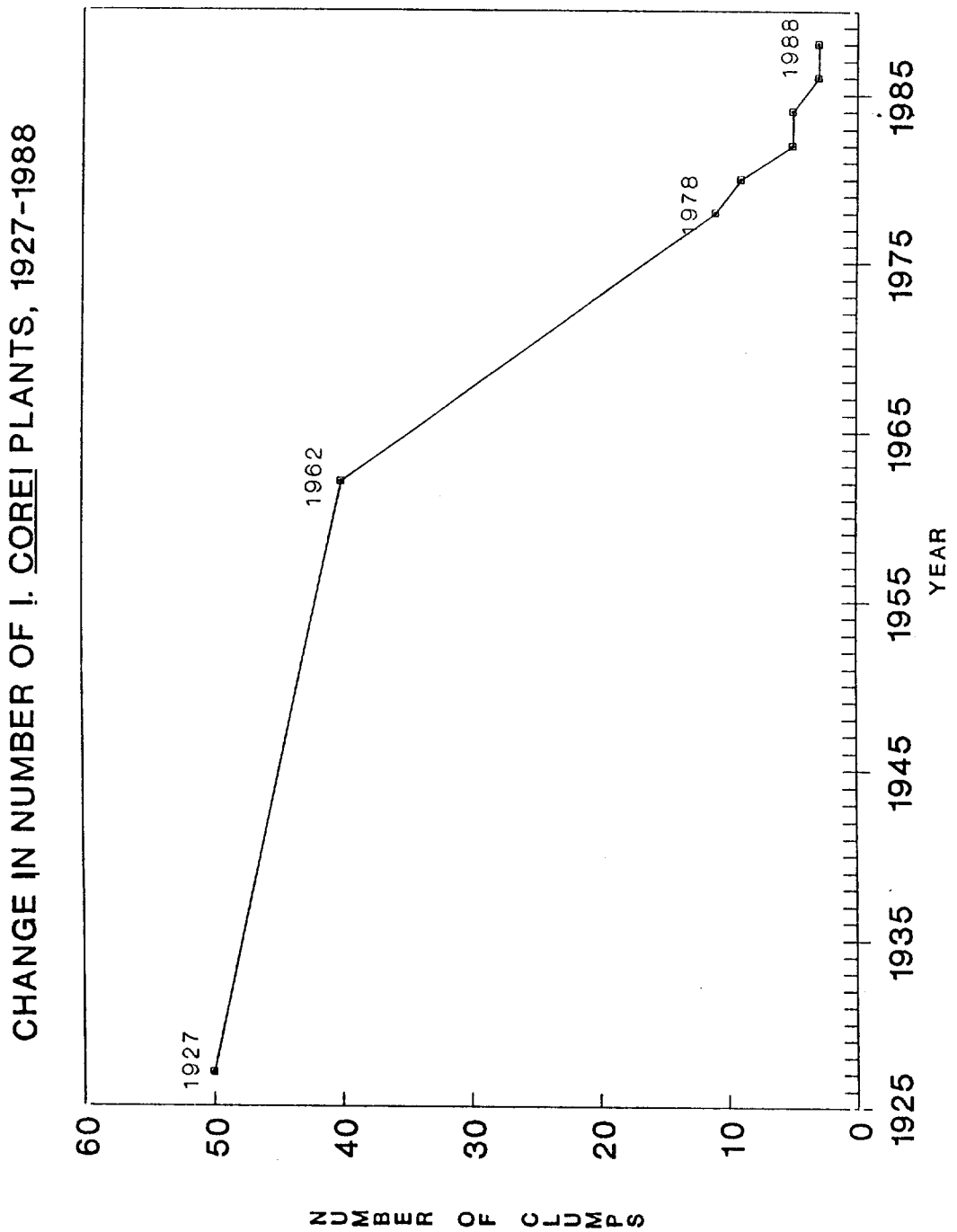


Figure 2. Iliamna corei population trend

Description and Taxonomy

Iliamna corei is an erect, ascending, perennial herb growing from a woody rhizome producing densely pubescent pale-green branches up to 1 m in height (Figure 3). The maple-like leaves are simple, with 5-7 palmate lobes, margins serrate to dentate, bases truncate to cordate, and stellate-pubescent on both surfaces. The size of the leaves decreases gradually towards the tips of the branches. The pink flowers are solitary or clustered in the axils of the upper leaves. There are 5 radially symmetrical, separate petals 2.5-3 cm long and 5 sepals fused 1/4 to 1/2 their length into a bell-shaped, hairy calyx. Stamens are numerous, their bases fused into a tube surrounding the pistil. The flower appears generally similar to the cultivated hibiscus, or rose-of-Sharon. Fruits are lobed capsules with mature carpels 8-10 mm long, densely hairy, containing 2-3 seeds in each carpel.

There has been considerable confusion over the taxonomic status of I. corei due to its close affinity with Iliamna remota, a candidate for Federal listing. Therefore, a brief overview of the taxonomic history of the two species is warranted. The first collections of Iliamna remota were made in 1872, by E.J. Hill, on a gravelly island in the Kankakee River near Altorf, Illinois. The plants were identified as a western species of mallow, Sphaeralcea acerifolia. Greene (1906) recognized differences between the Illinois plants and the widespread western species, and described the Kankakee River plants as Iliamna remota. Fernald (1908) transferred the Kankakee plants back to the genus Sphaeralcea under the name Sphaeralcea remota. In 1912 Britton transferred S. remota to Phymosia remota.

When Core discovered Iliamna corei on Peters Mountain in 1927, he identified it as Phymosia remota (Strausbaugh and Core, 1932). Sherff (1946) compared the Illinois and Virginia plants and concluded that the Kankakee River taxon belonged in Iliamna and that the Virginia taxon belonged within the species, but as Iliamna

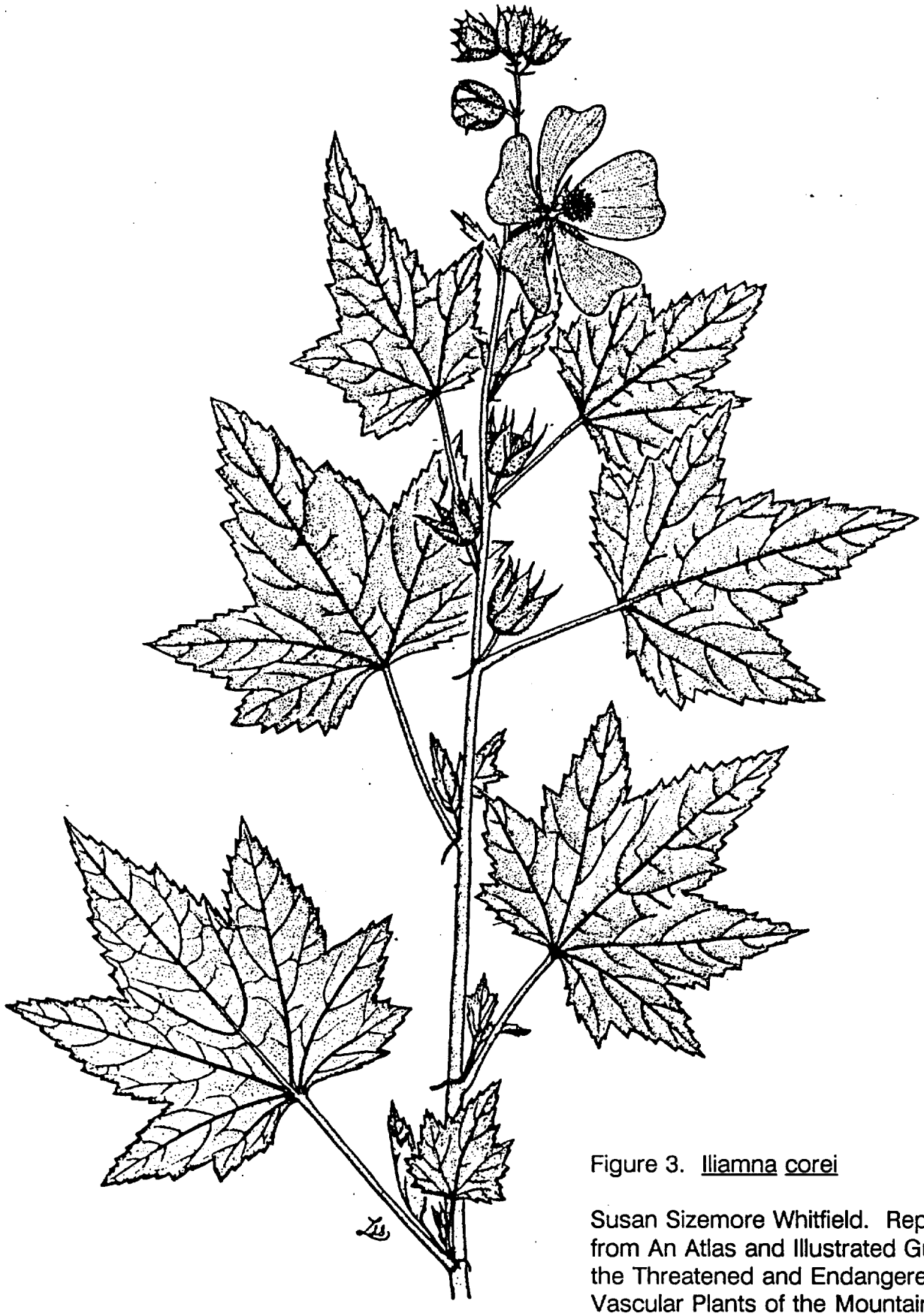


Figure 3. Iliamna corei

Susan Sizemore Whitfield. Reprinted from An Atlas and Illustrated Guide to the Threatened and Endangered Vascular Plants of the Mountains of NC and VA. J.R. Massey et al. 1983.

remota var. corei. Later Sherff (1949) recognized that the Illinois and Virginia plants were distinct at the species level; the Illinois plants were maintained as I. remota and the Virginia plants were elevated to specific status as I. corei.

It is now recognized by most workers that I. corei is distinct from I. remota. The primary differences in the two species are growth habit and inflorescence structure. Iliamna corei is much less robust than I. remota; it grows to only 1 m in height, while I. remota generally exceeds 2 m in height. The inflorescence of I. corei has few branches while the inflorescences of I. remota branch considerably. I. corei flowers are odorless, while those of I. remota are reportedly very fragrant. Furthermore, the capsules of I. corei are much less hairy than those of I. remota (J. Randall, VPI&SU, pers. comm.). Leaf morphological characteristics have also been used to separate the two species, but these tend to grade between the two.

Ecology and Life History

Iliamna corei occurs in the shallow soil of the Clinch sandstone outcrops on the northwest-facing slope of Peters Mountain (elevation 1000 m), near the ridge line of a mixed deciduous-evergreen forest. The dominant trees growing in association with I. corei include Quercus rubra, Q. prinus, Carya spp., Robinia pseudo-acacia, Pinus virginiana, Betula lenta, and Celtis occidentalis. The shrub layer is primarily composed of Berberis canadensis, Crategus spp., and Rhus typhina. The more common herbs, forbs, and vines include Verbesina occidentalis, Tradescantia ohiensis, Polymnia canadensis, Aquilegia canadensis, Chenopodium standleyanum, Rosa carolina, Dioscorea villosa, Clematis viorna, and Parthenocissus quinquefolius. The only plants that appear to be directly competing with the Iliamna are Polymnia and Berberis.

Mature Iliamna corei plants appear to prefer open sites without much competing vegetation. Although they will tolerate some shading, the largest clone occurs in the most exposed location. Evidence of fire (charcoal, scarred trees) is common on Peters Mountain, but fires have been suppressed in recent years.

Regarding the species' edaphic requirements, soil tests from the sites of two different Iliamna clones show pH ranging from 5.3 to 5.6. Quantities of macro-and micronutrients from the two sites (in parts per million) include: phosphorus (32 and 53), potassium (157 and 58), calcium (120), and magnesium (101 and 65). Soils underlying the Iliamna population are very dark and appear to be highly organic in composition.

I. corei flowers from late June to early August. It is believed to be pollinated primarily by sweat bees of the genus Halictus, which are abundant in the area. Fruits normally appear from July to September, but in recent years, there have been severe problems with fruit and seed set in the natural population, as described below.

Reasons For Listing

Reasons for the rarity of Iliamna corei are not well understood. Even prior to its discovery, the decline of the species may have been initiated by fire suppression, which inhibited germination and promoted the invasion of weedy competitors. The precipitous decline of the I. corei population in the last 20 years is attributed to these factors combined with others including habitat alterations, deer browsing, lack of opportunity for outcrossing, and herbicides sprayed on a nearby powerline right-of-way. The existence of the single population in the wild is also threatened by chance events, such as disease or insect infestation.

The encroachment of competing vegetation, resulting in a reduction of direct sunlight reaching the plants, appears to be contributing to the decline in the size and reproductive vigor of the population. Historical references indicate that Iliamna corei was previously exposed to a great deal more direct sunlight than is the case today (U.S. Fish and Wildlife Service, 1986). In recent years forest canopy on Peters Mountain has grown considerably, probably in association with fire suppression management. Construction of a hiking trail and a powerline near the mallow site in the early 1970s appears to have promoted the invasion of weedy competitors, primarily Polymnia canadensis.

Because so few plants comprise the natural population, removal of individual stems, whether by humans or other animals, constitutes a threat to the species' survival. In October 1987, a feral goat browsed all of the Iliamna stems to within 30 cm of the ground. In 1987 and 1988, a total of 16 stems were cut, apparently for collection.

A major concern in regard to recovery of Iliamna corei has been lack of recruitment. Although a viable seedbank exists in the soil, no seedlings are being produced because the seeds are not germinating. Recent experimental evidence indicates that germination is readily stimulated by heat (Baskin and Baskin, 1990) and light fire (C. Baskin and J. Baskin, pers. comm.).

In addition to the lack of seed germination at the natural population site, the remaining I. corei clones have been exhibiting extremely low sexual fecundity. From 1986-1988, only 14 mature capsules were produced, despite profuse flowering. Many buds aborted before flowering, and the majority of buds that did produce flowers disarticulated from the plant after anthesis. The record drought years of 1987 and 1988 may have contributed to reproductive failure; however, the plants were watered regularly during the drought periods of those years. Seed production data from most of the years previous to 1986 are unavailable, but

Strausbaugh and Core indicated that, in 1932, the plants were producing an "abundant supply of seeds." Herbarium specimens collected by Massey in 1934 and 1939 (at VPI&SU) also have mature capsules containing many seeds (J. Randall, pers. comm.). The mystery of seed production in the natural population has been largely solved and the problem ameliorated by recent work at VPI&SU, as described below.

Conservation Measures and Current Research

The Commonwealth of Virginia lists Iliamna corei as endangered under state law. Under the State Endangered Plant and Insect Species Act, it is unlawful to dig, cut, process or collect, remove, transport, possess, sell, offer for sale, or give away listed plants other than from one's own land. Because the Federal Endangered Species Act prohibits the collecting of endangered or threatened plants on non-Federal lands only in association with violation of other laws, the listing of I. corei under state law provides an important degree of protection.

Beginning in 1986, I. corei has been studied and managed by botanists at VPI&SU. Recent seed germination work has been conducted at the University of Kentucky in Lexington. These activities have been funded by the U.S. Fish and Wildlife Service, Virginia Bureau of Plant Protection, and The Nature Conservancy (TNC). TNC has also been actively working on acquiring the tract of land on which I. corei occurs. Presently they own one-quarter interest in the site and are in the process of acquiring the remaining interest in the property.

Management and recovery work accomplished thus far on I. corei is summarized below.

1. Direct management: In 1986, all plants were fenced with chicken wire cages to prevent browsing by deer. Competing herbs and shrubs, as well as some of the canopy shading the plants, were removed. During the growing seasons of 1987 and 1988, water was carried up to the plants to alleviate adverse effects of the prevailing drought conditions.

2. Surveys for additional sites: From 1986 through 1989, searches were made along the entire outcrop of Clinch sandstone on which I. corei grows, as well as on other sandstone outcrops providing similar habitat in the area. No new populations were located.

3. Studies of genetic variability: Preliminary studies of isozyme variation in the leaves of I. corei and I. remota have been conducted. Results so far indicate polymorphisms at 5 loci in both Iliamna species.

4. Seed collection and germination: From 1986 through 1988, substrate samples were collected from a number of 1/4 meter plots at the natural population site. The samples, which included surface leaf litter plus the first few millimeters of the organic soil layer, were painstakingly sifted in search of the tiny I. corei seeds. As a result of this diligent effort, over 95 I. corei seeds were unearthed. It was found that scarifying the seed coats was necessary to induce germination. Seeds germinated within 24 hours of being nicked with a razor blade. Seedlings were grown at VPI&SU experimental gardens, with the assistance of the horticulture department.

As of late summer 1988, 33 I. corei plants in the VPI&SU gardens were growing vigorously. Five of seven plants grown from seeds collected in 1987 flowered profusely and produced an abundance of viable seed capsules. These have yielded a total of some 35,000 seeds. Additional seedlings germinated from seed collected in 1988 were given to the North Carolina Botanical Garden for

propagation and conservation work. Thus, although the number of plants remaining in the original population is down to four and these are generally not producing seeds, the outlook for recovery is vastly improved by the presence of a potentially large and viable seed bank in the wild and the plants' prolific seed production under cultivation. The availability of an abundant supply of seeds and flowering plants has enabled researchers to conduct life-history studies that are necessary to promote recovery of the species, as described below.

5. Seed dormancy studies: Experiments conducted in 1989 at the University of Kentucky by J. and C. Baskin have provided a wealth of information on breaking dormancy in I. corei seeds. Their interim report (Baskin and Baskin, 1990) indicates:

a. Following mechanical scarification, virtually all I. corei seeds will germinate at 12-hour thermoperiods ranging from $20^0/10^0$C to $35^0/20^0$C, either in the light or in the dark. Without scarification, little or no germination occurs under any conditions.

b. Heating the seeds in a laboratory drying oven for 30 to 60 minutes at 70^0C to 110^0C stimulates germination. Seeds exposed to higher temperatures (110^0-140^0C) for one minute also showed some germination.

c. Exposing the seeds to fluctuating temperatures is ineffective in breaking dormancy (C. Baskin, pers. comm.).

d. Freezing and thawing the seeds also does not break dormancy.

e. Exposing the seeds to simulated fires of the leaf litter stratum shows promise in breaking dormancy, but further experiments are necessary.

6. Analysis of breeding system: After determining the period of stigma receptivity on I. corei flowers grown in the experimental garden at VPI&SU, cross-pollination experiments were conducted at the natural population site. Flower stamens were removed, and the stigmas were pollinated with pollen from one of three sources: (a) experimental garden flowers, (b) flowers from the same clone, or (c) flowers from another clone on Peters Mountain. The results were strikingly clear. All cross-pollinations resulted in capsule and seed formation, and all intraclonal pollinations resulted in flower abortion. Although these results should be replicated with larger sample sizes, they indicate that Iliamna corei is self-incompatible. These results were substantiated by a late season flush of synchronous flowering among clones in 1989, which presented an unprecedented opportunity for natural inter-clonal pollination to occur. A total of nearly 250 capsules resulted. All of these were collected; they yielded a total of some 8500 seeds.

7. Seedling survival experiments: Preliminary attempts have been made to grow seedlings at the natural population site under 4 conditions: in sun or shade, and with or without competing vegetation. Results to date have been inconclusive, due to methodological difficulties.

Strategy for Recovery

Given the restriction of Iliamna corei to a single historical site and the likelihood that it will always require active management, it may be that the species can never be recovered beyond threatened status. It is possible that the species was already in a state of decline at the time it was discovered. The most recent research indicates that fire suppression, a practice already in operation at the time of its discovery, may have been a primary factor contributing to the original decline of I. corei. It is impossible to determine the pre-fire suppression distribution and

abundance of this mallow. In the absence of this information, we are, for the purposes of this plan, making the assumption that the species was at one time more abundant than it was at the time of its discovery. Thus, the species' recovery goal for number of individuals comprising the natural population will be set based on carrying capacity of the habitat rather than number of individuals known historically. Similarly, the possibility of establishing additional populations elsewhere on Peters Mountain will be considered as a recovery tool. However, such action will not be taken until the full suite of the species' life history requirements and ecological milieu are understood, and the results indicate that population establishment is appropriate.

The strategy for recovery involves the following actions: (1) Continue to monitor and maintain the natural population. (2) Complete life history and ecological studies to determine management techniques that are necessary to maintain and expand the natural population and to determine the appropriateness of establishing additional populations. (3) Implement appropriate management techniques. (4) Maintain I. corei populations at a minimum of two plant propagation facilities, and (5) Establish additional populations on Peters Mountain, if ecological studies indicate that such action is warranted.

PART II: RECOVERY

Recovery Objective:

To remove Iliamna corei from the List of Endangered and Threatened Wildlife and Plants.

Due to its natural rarity and to the lack of ecological information necessary to determine the appropriateness of establishing additional populations, it is not known whether complete delisting will be possible. The results of future research will indicate whether the conditions set forth below for delisting are achievable. The goals contained in this plan are meant to direct research and management efforts to acquire the information necessary to make this decision.

Downlisting from endangered to threatened will be possible when all of the following conditions are met:

1. The natural population has reached carrying capacity of the 322-acre site and is demonstrably self-maintaining or expanding into adjacent habitat for a period of at least five years.

2. Life history, ecological and population parameters are understood sufficiently to ensure effective management.

3. There exists a permanent monitoring/management program, as necessary.

4. The tract of land on which it occurs is in permanently protected status.

5. Plants representing a variety of genotypes are maintained in propagation at a minimum of two established plant breeding facilities.

Delisting will be considered when, in addition to the above conditions having been met:

6. Ecological studies and site investigations indicate that appropriate sites for establishment of additional I. corei populations exist on Peters Mountain.

7. At least five additional populations have been located or established.

8. These populations are permanently protected, monitored and managed, as is the natural population.

9. These new populations have proven to be self-maintaining or expanding for a period of at least 5 years.

Note from conditions 3 and 8 that continued monitoring and management of this species may be required in perpetuity. It is likely, for example, that fire or another type of active management will be found necessary to promote reproduction or some other aspect of this species' viability. Delisting will not be possible unless management in perpetuity can be assured.

Narrative Outline

1.0 Monitor and maintain the natural population.

Bimonthly visits should be made to the population during the growing season to manage the plants and to gather data on flowering and seed set.

Management activities that may be required include removal of competing vegetation, caging the plants to eliminate deer browsing, and watering during drought. Under certain extreme conditions (e.g., drought) more frequent site visits may be required.

2.0 Proceed with acquisition efforts.

TNC has already acquired one-quarter interest in the 322-acre tract on which the plants occur and is in the final stages of acquiring the remaining interest. Acquisition in full will assure permanent protected status and to allow complete management authority.

3.0 Study and describe life history, ecological, and population parameters.

3.1 Determine the importance of fire to germination and maintenance of I. corei.

It has been found that under laboratory conditions, mechanical scarification, exposure to heat and light fires are very effective in inducing germination. However, the role of fire under natural conditions must be determined, for effective management. Fire research needs to be conducted at the natural population site, at sites nearby but not contiguous to the natural population site and at potential introduction sites.

It appears that maintaining stable or expanding populations of I. corei at the natural population site will require a fire management regime in which small patches are occasionally burned, while large areas are left alone. Very carefully controlled research burns will be conducted on-site to determine the direct effects of fires on germination, growth

and mortality of I. corei as well as their indirect effects (e.g. nutrient changes in the soil, increased herbivory, elimination of competitors).

At sites nearby but not contiguous to the natural population site, established methods of prescribed burning will be used to trigger the germination of long dormant or recently dispersed seeds and to enhance light regimes required for seedling establishment. This will facilitate expansion of the natural population.

At sites targeted for potential introduction of I. corei, fire research should focus on seed bed preparation and enhancement of light regimes required for seedling establishment.

3.2 Investigate factors promoting or preventing fruit and seed set.

As indicated above, factors contributing to bud abortion and flower drop have been largely determined through studies conducted at VPI&SU in 1989. Apparently, the observed problems with seed set in I. corei are related to self-incompatibility among the few remaining plants at Peters Mountain. Some further cross-pollinations may be conducted, to increase sample sizes, but this task is virtually completed.

3.3 Study other factors necessary for successful growth and propagation.

These include factors promoting seedling survival, optimum growth, and induction of flowering, such as sun/shade regime and nutrient and water requirements. Knowledge of these requirements is vital to our implementing suitable management measures at the natural population site and at future transplant

sites, if any. Studies of certain of these factors were initiated at VPI&SU, in FY89 and will continue.

3.4 Develop an ecological model of I. corei as it relates to plant community and ecosystem dynamics.

I. corei should be described through all its developmental stages as an element of the community in which it occurs, noting changes and stability of populations at the community level, ecosystem characteristics and other species in the community that influence or are influenced by I. corei. Natural and human-induced disturbances should be described as well. As interactions with other species and conspecifics are more fully understood, it should be possible to determine the carrying capacity of I. corei at its only known population site. Development of this model and its application at other sites on Peters Mountain will enable us to determine whether there exist sites similar enough to the natural population site that establishment of additional populations may be considered, and, if so, what the carrying capacity of I. corei at these sites should be.

3.5 Develop a population genetics model.

The purpose of this model would be to determine the number of populations and effective population sizes necessary to maximize the probability of long-term survival, as these relate to the carrying capacity of the habitat at each population site. Data from Task 5.0 will be required to complete this task.

4.0 Implement appropriate management measures.

4.1. Implement measures in perpetuity at the natural population site.

Based on results of studies described in Tasks 3.1 to 3.3, certain management actions may be found to be necessary. For example, controlled burns will likely be required to stimulate germination and to maintain population vigor. These and other actions found necessary should be implemented in a manner that will ensure their continuation even after the species is delisted, should this occur.

4.2 Search for additional populations/appropriate reintroduction sites.

Additional populations, if found, would contribute greatly to the species' recovery both by decreasing the likelihood of extinction at the one known site and by increasing the species' genetic base. However, many areas of similar habitat (Clinch sandstone outcrops) in the vicinity of the known population have already been searched, with no success. Some searching of remaining high-potential habitat should be made. Although it is unlikely that more populations will be located, such searches will also serve to identify potential sites for population establishment, as necessary for complete recovery. Tasks 3.4 and 3.5 will enable us to determine whether additional populations should be established, and if so, what target population sizes and numbers of populations should be.

4.3 Outplant I. corei within the historic range.

Due to our lack of historic distribution data and the extremely limited present range, we are considering that the historic range may have

included habitat similar to that of the known population (i.e., Clinch sandstone outcrops with similar community structure) on Peters Mountain. Transplants of propagated individuals should not be attempted, however, unless: (1) the results of ecological modeling indicate that other sites on Peters Mountain contain very similar (or, based on the model, "identical") community structures, and (2) life history requirements of Iliamna corei are sufficiently understood to ensure a high probability of success. With regard to the natural population, it is highly preferable to induce population expansion from the seedbank, rather than from material propagated off-site, due to the low genetic variability of transplanted seedlings, relative to plants that would be produced through natural germination.

5.0 Analyze genetic variability.

This information is necessary to determine numbers of individuals per population and number of populations necessary for long-term survival. These studies may also help ensure that propagules represent the widest possible genetic diversity. Preliminary analysis of isozyme variation in leaves of I. corei have revealed some polymorphisms at 5 loci. Further, more detailed and extensive analyses should be conducted. The technique of "DNA fingerprinting" will be used to further describe the species' variability.

6.0 Propagate and maintain representative individuals in established plant breeding facilities.

Maintenance at a minimum of two such facilities would avert the potential danger of extinction should some adverse situation (e.g., forest fire, disease, vandalism) arise at the site of the natural population. These would also

serve as a source of propagated individuals for experimental work (Task 3.0) and possible outplantings (Task 4.3).

References

Baskin, J. M. & C. C. Baskin. 1990. Breaking dormancy in seeds of Iliamna corei. Interim Report to Virginia Dept. of Agriculture and Consumer Services, Plant Protection Div., Contract PMMOK-01-89.

Fernald, M. L. 1908. Notes on some plants of northeastern America. Rhodora 10:46-55.

Greene, E. L. 1906. Certain malvaceous types. Leaflets of Botanical Observation and Criticism. 1:205-209.

Keener, C. S. and J. W. Hardin. 1962. Iliamna corei revisited. Castanea 27:176-178.7

Sherff, E. E. 1946. Notes on certain plants in the Gray's Manual range. Rhodora 48:89-96.

_____. 1949. Miscellaneous notes on dicotyledonous plants. American Journal of Botany 36:499-511.

Strausbaugh, P. D. and E. L. Core. 1932. Phymosia remota. Rhodora 34:142-146.

U.S. Fish and Wildlife Service. 1986. Determination of Iliamna corei (Peters Mountain mallow) to be an endangered species. Final Rule. Federal Register 51(91):17343-46.

PART III: IMPLEMENTATION

Priorities in column four of the following implementation schedule are assigned as follows:

1. Priority 1 - All actions that are absolutely essential to prevent extinction of the species.

2. Priority 2 - All actions necessary to maintain the species' current population status.

3. Priority 3 - All other actions necessary to provide for full recovery of the species.

KEY TO ABBREVIATIONS USED IN IMPLEMENTATION SCHEDULE

FWE - Fish and Wildlife Enhancement
FWS - Fish and Wildlife Service
CPC - Center for Plant Conservation
NCBG - North Carolina Botanic Garden
TNC - The Nature Conservancy
VPI&SU - Virginia Polytechnic Institute and State University
VDACS - Virginia Department of Agriculture and Consumer Services

Asterisk (*) indicates lead agency.

IMPLEMENTATION SCHEDULE

Peters Mountain Mallow
September, 1990

Priority	Task Number	Plan Task	Task Duration	Responsible Agencies		Costs ($000)			Comments
				USFWS*	Other	FY1	FY2	FY3	
1	1.0	Monitor and maintain population	Ongoing	R5 FWE	VDACS VPI&SU TNC*	2.0 0.5	2.0 0.5	2.0 0.5	
1	3.1	Determine importance of fire to germination and maintenance of I. corei	3 years	R5 FWE	VDACS*	2.5 0.5	5.0 1.0	5.0 1.0	
1	4.1	Manage natural population as appropriate	Ongoing	R5 FWE	VDACS VPI&SU* TNC		2.0	2.0	Based on results of Tasks 3.1-3.3
1	6.0	Propagate and maintain in breeding facilities	Ongoing (funds for 2 years)	R5 FWE	VPI&SU NCBG CPC*		2.0	2.0	
2	2.0	Acquire known site	1 year		TNC*		60.0		
2	3.2	Investigate factors affecting seed set	2 years	R5 FWE	VDACS VPI&SU*	2.0 0.5	2.0 0.5		Virtually completed
2	5.0	Analyze genetic variability	3 years	R5 FWE	VDACS		2.2 0.8	2.2 0.8	
3	3.3	Study other life history factors	3 years	R5 FWE	VDACS*		3.5 1.0	3.5 1.0	
3	3.4	Develop ecological model	1 year	R5 FWE	VDACS*		2.0 0.5	2.0 0.5	

Peters Mountain Mallow Implementation Schedule (page 2)
September, 1990

Priority	Task Number	Plan Task	Task Duration	Responsible Agencies		Costs ($000)			Comments
				USFWS	Other	FY1	FY2	FY3	
3	3.5	Develop population model	1 year	R5 FWE	VDACS*			1.0 0.5	
3	4.2	Search for populations and transplant sites	1 year	R5 FWE	VDACS VPI&SU* TNC			2.0 0.5	Based on results of Task 3.4
3	4.3	Outplant propagated individuals	3 years	R5 FWE	VDACS VPI&SU TNC				

* Lead agency

PART IV: LIST OF REVIEWERS

Karen A. Caljouw
J. Christopher Ludwig
Virginia Natural Heritage Program
203 Governor Street, Suite 402
Richmond, VA 23219

Skip Grieb
Jefferson National Forest
210 Franklin Road S.W.
Roanoke, VA 24001

M.V. Lipscomb
D.M. Porter
C.N. Stewart
T.F. Wieboldt
Biology Department - Herbarium
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061

Raymond Matheny
Office of Pesticide Programs
Environmental Fate and Effects Division
Ecological Effects Branch
U.S. Environmental Protection Agency
401 M Street S.W.
Washington, D.C.

E.B. Robinson, Jr.
P.O. Box 190
Elmwood Park, New Jersey 07407